10/560995

CofC

Docket No.: 07700/066001
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Letters Patent of:
Hideo Morimoto

Patent No.: 7,360,456

Issued: April 22, 2008

For: MULTI-AXIS SENSOR

REQUEST FOR CERTIFICATE OF CORRECTION
PURSUANT TO 37 CFR 1.322

Attention: Certificate of Correction Branch
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Upon reviewing the above-identified patent, Patentee noted typographical errors which should be corrected.

In the Claims:

In Claim 2, column 27, line 5, "in" should be --**is**--.

In Claim 11, column 28, line 22, "tat" should be --**that**--.

The errors were not in the application as filed by applicant; accordingly no fee is required.

Transmitted herewith is a proposed Certificate of Correction effecting such amendment. Also enclosed, as evidence of the error, is a copy of the claims as issued, and a

copy of the Amendments to the Claims. Patentee respectfully solicits the granting of the requested Certificate of Correction.

Applicant believes no fee is due with this request. However, if a fee is due, please charge our Deposit Account No. 50-0591, under Order No. 07700/066001.

Dated: June 24, 2008

Respectfully submitted,

By

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[FIG. 23]

A central vertical sectional front view showing a multiaxial sensor according to a sixth embodiment.

[FIG. 24]

A plan view showing the arrangement of strain gauges when the multiaxial sensor according to the sixth embodiment is transparently viewed in the reverse direction of the Z axis.

[FIG. 25]

A central vertical sectional front view showing displacement when an acceleration ax is applied to the multiaxial sensor.

[FIG. 26]

A plan view showing changes in the resistance values of the strain gauges when the acceleration ax is applied to the multiaxial sensor.

[FIG. 27]

A central vertical sectional front view showing displacement when an acceleration az is applied to the multiaxial sensor.

[FIG. 28]

A plan view showing changes in the resistance values of the strain gauges when the acceleration ax is applied to the multiaxial sensor.

[FIG. 29]

A central vertical sectional front view showing displacement when an angular acceleration alpha y is applied to the multiaxial sensor.

[FIG. 30]

A plan view showing changes in the resistance values of the strain gauges when the angular acceleration alpha y is applied to the multiaxial sensor.

[FIG. 31]

A plan view showing changes in the resistance values of the strain gauges when an angular acceleration alpha z is applied to the multiaxial sensor.

[FIG. 32]

Circuit diagrams showing examples of bridge circuits for the multiaxial sensor.

[FIG. 33]

Circuit diagrams showing examples of bridge circuits according to a seventh embodiment.

[FIG. 34]

A plan view showing a multiaxial sensor according to an eighth embodiment.

[FIG. 35]

A central vertical sectional front view showing the multiaxial sensor according to the eighth embodiment.

[FIG. 36]

A central vertical sectional front view showing a multiaxial sensor according to a ninth embodiment.

[FIG. 37]

A plan view showing the arrangement of strain gauges when a multiaxial sensor according to the ninth embodiment is Z-axially transparently viewed from the position of a second member.

[FIG. 38]

A central vertical sectional front view showing displacement when a force Fx is applied to the multiaxial sensor.

[FIG. 39]

A plan view showing changes in the resistance values of the strain gauges when the force Fx is applied to the multiaxial sensor.

[FIG. 40]

A central vertical sectional front view showing displacement when a force Fz is applied to the multiaxial sensor.

[FIG. 41]

A plan view showing changes in the resistance values of the strain gauges when the force Fz is applied to the multiaxial sensor.

[FIG. 42]

A central vertical sectional front view showing displacement when a force Mx is applied to the multiaxial sensor.

[FIG. 43]

A plan view showing changes in the resistance values of the strain gauges when the force Mx is applied to the multiaxial sensor.

[FIG. 44]

A plan view showing changes in the resistance values of the strain gauges when a force Mz is applied to the multiaxial sensor.

[FIG. 45]

Circuit diagrams showing examples of bridge circuits for the multiaxial sensor.

[FIG. 46]

A circuit diagram showing an example of a dummy circuit.

[FIG. 47]

A plan view showing the arrangement of strain gauges when a multiaxial sensor according to a tenth embodiment is Z-axially transparently viewed from the position of a second member.

[FIG. 48]

Circuit diagrams showing examples of bridge circuits according to the tenth embodiment.

[FIG. 49]

A perspective view showing a prior art multiaxial sensor.

DESCRIPTION OF REFERENCE NUMERAL

1: multiaxial sensor
2: first member
3: second member
4, **5**, **6**, **7**: diaphragm
8: central shaft
10: piezoresistance element
16, **17**, **18**, **19**: operative body
R11 to **R48**, **R111** to **R148**: strain gauge

The invention claimed is:

1. A 6-axis sensor for measuring 6-axis forces and moments or 6-axis accelerations and angular accelerations, externally applied, characterized by comprising:

a plurality of strain gauges disposed on one plane;

a plurality of first diaphragms to which the plurality of strain gauges are attached;

a first member comprising one of the plurality of first diaphragms;

a second member comprising a second diaphragm opposed to the one of the plurality of first diaphragms and provided with a plurality of strain gauges disposed on one plane; and

a connecting shaft connecting the opposed first and second diaphragms;

wherein the plurality of first diaphragms are arranged around a central point of the plane at regular angular intervals and at the same distance from the central point;

6-axis forces and moments applied between the first and second members are measured;

the strain gauges of the first member and the strain gauges of the second member are disposed symmetrically with respect to a barycentric point of the 6-axis sensor; and

either outputs of the strain gauges of the first member and the strain gauges of the second member are adopted if the other ouputs are out of a predetermined range.

2. The 6-axis sensor according to claim 1, characterized in that the angular interval in 90 degrees.

3. The 6-axis sensor according to claim 1, characterized in that the diaphragms are disposed in positive and negative direction on X and Y axes with an origin being defined at the central point.

4. The 6-axis sensor according to claim 1, characterized in that the angular interval is 120 degrees.

5. The 6-axis sensor according to claim 1, characterized in that a thin portion of each of the plurality of first diaphragms is annular and provided with eight strain gauges, and

the strain gauges are disposed at outer and inner edge portions of each of the plurality of first diaphragms on a line extending between a central point of each of the plurality of first diaphragms and the central point of the plane, and at outer and inner edge portions of each of the plurality of first diaphragms on a line perpendicular to the former line at the central point of each of the plurality of first diaphragms.

6. The 6-axis sensor according to claim 1, characterized in that the 6-axis sensor further comprises an operative body provided on a central portion of one or more of the plurality of first diaphragms, and

6-axis accelerations and angular accelerations applied to the 6-axis sensor are measured.

7. The 6-axis sensor according to claim 1, characterized in that each of the strain gauges is made of a piezoresistance element.

8. The 6-axis sensor according to claim 1, characterized in that each of the strain gauges is made of a thin film of chromium oxide formed on an insulating film.

9. A 6-axis sensor for measuring 6-axis forces and moments or 6-axis accelerations and angular accelerations, externally applied, the 6-axis sensor comprising:

a plurality of strain gauges disposed on one plane;

a plurality of first diaphragms to which the plurality of strain gauges are attached;

wherein only one of the plurality of first diaphragms is disposed on the plane;

a first member comprising one of the plurality of first diaphragms;

a second member comprising a second diaphragm provided with a plurality of strain gauges disposed on one plane; and

operative bodies connecting the first and second diaphragms,

wherein the first and second members are disposed so that a central point of the first diaphragm of the first member is opposed to a central point of the second diaphragm of the second member,

wherein the operative bodies connects the first and second diaphragms at positions arranged around the central points of the first and second diaphragms at regular angular intervals and at the same distance from the central points, and 6-axis forces and moments applied between the first and second members are measured,

wherein the strain gauges of the first member and the strain gauges of the second member are disposed symmetrically with respect to a barycentric point of the 6-axis sensor, and

wherein either outputs of the strain gauges of the first member and the strain gauges of the second member are adopted if the other outputs are out of a predetermined range.

10. The 6-axis sensor according to claim 9, characterized in that the angular interval is 90 degrees.

11. The 6-axis sensor according to claim 9, characterized in tat the operative bodies are disposed in positive and negative directions on X and Y axes with an origin being defined at the central point of the first diaphragm.

12. The 6-axis sensor according to claim 9, characterized in that the angular interval is 120 degrees.

13. The 6-axis sensor according to claim 9, characterized in that the strain gauges are disposed:

at edge portions of the operative bodies on a line extending between a central point of a portion on the plane corresponding to the operative bodies, and the central point of the first diaphragm;

at edge portions of the operative bodies on a line perpendicular to the former line at the central point of the portion on the plane corresponding to the operative bodies; and

at either of edge portions of the operative bodies and edge portions of the first diaphragm, at positions arranged around the central point of the first diaphragm at regular angular intervals and at the same distance from the central point.

14. The 6-axis sensor according to claim 9, characterized in that each of the strain gauges is made of a piezoresistance element.

15. The 6-axis sensor according to claim 9, characterized in that each of the strain gauges is made of a thin film of chromium oxide formed on an insulating film.

* * * * *

AMENDMENTS TO THE CLAIMS

Please amend the claims as follows.

1. (Currently Amended) A 6-axis sensor for measuring 6-axis forces and moments or 6-axis accelerations and angular accelerations, externally applied, characterized by comprising:

   a plurality of strain gauges disposed on one plane; ~~and~~

   a plurality of first diaphragms to which the plurality of strain gauges are attached;

   a first member comprising one of the plurality of first diaphragms;

   a second member comprising a second diaphragm opposed to the one of the plurality of first diaphragms and provided with a plurality of strain gauges disposed on one plane; and

   a connecting shaft connecting the opposed first and second diaphragms;

   wherein the plurality of first diaphragms are arranged around a central point of the plane at regular angular intervals and at the same distance from the central point;

   6-axis forces and moments applied between the first and second members are measured;

   the strain gauges of the first member and the strain gauges of the second member are disposed symmetrically with respect to a barycentric point of the 6-axis sensor; and

   either outputs of the strain gauges of the first member and the strain gauges of the second member are adopted if the other outputs are out of a predetermined range.

2. (Canceled)

3. (Canceled)

4. (Previously Presented) The 6-axis sensor according to claim 1, characterized in that the angular interval is 90 degrees.

5. (Previously Presented) The 6-axis sensor according to claim 1, characterized in that the diaphragms are disposed in positive and negative directions on X and Y axes with an origin being defined at the central point.

6. (Previously Presented) The 6-axis sensor according to claim 1, characterized in that the angular interval is 120 degrees.

7. (Previously Presented) The 6-axis sensor according to claim 1, characterized in that a thin portion of each of the plurality of first diaphragms is annular and provided with eight strain gauges, and

   the strain gauges are disposed at outer and inner edge portions of each of the plurality of first diaphragms on a line extending between a central point of each of the plurality of first diaphragms and the central point of the plane, and at outer and inner edge portions of each of the plurality of first diaphragms on a line perpendicular to the former line at the central point of ~~the~~ each of the plurality of first diaphragms.

8. (Previously Presented) The 6-axis sensor according to claim 1, characterized in that the 6-axis sensor further comprises an operative body provided on a central portion of one or more of the plurality of first diaphragms, and

   6-axis accelerations and angular accelerations applied to the 6-axis sensor are measured.

9. (Canceled)

10. (Canceled)

11. (Canceled)

12. (Canceled)

13. (Canceled)

14. (Canceled)

15. (Canceled)

16. (Previously Presented) A 6-axis sensor for measuring 6-axis forces and moments or 6-axis accelerations and angular accelerations, externally applied, the 6-axis sensor comprising:

   a plurality of strain gauges disposed on one plane;

   a plurality of first diaphragms to which the plurality of strain gauges are attached;

wherein only one of the plurality of first diaphragms is disposed on the plane;

a first member comprising one of the plurality of first diaphragms;

a second member comprising a second diaphragm provided with a plurality of strain gauges disposed on one plane; and

operative bodies connecting the first and second diaphragms,

wherein the first and second members are disposed so that a central point of the first diaphragm of the first member is opposed to a central point of the second diaphragm of the second member,

wherein the operative bodies connects the first and second diaphragms at positions arranged around the central points of the first and second diaphragms at regular angular intervals and at the same distance from the central points, and 6-axis forces and moments applied between the first and second members are measured,

wherein the strain gauges of the first member and the strain gauges of the second member are disposed symmetrically with respect to a barycentric point of the 6-axis sensor, and

wherein either outputs of the strain gauges of the first member and the strain gauges of the second member are adopted if the other outputs are out of a predetermined range.

17. (Canceled)

18. (Canceled)

19. (Canceled)

20. (Canceled)

21. (Canceled)

22. (Canceled)

23. (Previously Presented) The 6-axis sensor according to claim 1, characterized in that each of the strain gauges is made of a piezoresistance element.

24. (Previously Presented) The 6-axis sensor according to claim 1, characterized in that each of the strain gauges is made of a thin film of chromium oxide formed on an insulating film.

25. (Canceled)

26. (Canceled)

27. (Previously Presented) The 6-axis sensor according to claim 16, characterized in that the angular interval is 90 degrees.

28. (Previously Presented) The 6-axis sensor according to claim 16, characterized in that the operative bodies are disposed in positive and negative directions on X and Y axes with an origin being defined at the central point of the first diaphragm.

29. (Previously Presented) The 6-axis sensor according to claim 16, characterized in that the angular interval is 120 degrees.

30. (Previously Presented) The 6-axis sensor according to claim 16, characterized in that the strain gauges are disposed:

at edge portions of the operative bodies on a line extending between a central point of a portion on the plane corresponding to the operative bodies, and the central point of the first diaphragm;

at edge portions of the operative bodies on a line perpendicular to the former line at the central point of the portion on the plane corresponding to the operative bodies; and

at either of edge portions of the operative bodies and edge portions of the first diaphragm, at positions arranged around the central point of the first diaphragm at regular angular intervals and at the same distance from the central point.

31. (Previously Presented) The 6-axis sensor according to claim 16, characterized in that each of the strain gauges is made of a piezoresistance element.

32. (Previously Presented) The 6-axis sensor according to claim 16, characterized in that each of the strain gauges is made of a thin film of chromium oxide formed on an insulating film.

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 7,360,456

APPLICATION NO. : 10/560,995

ISSUE DATE : April 22, 2008

INVENTOR(S) : Hideo Morimoto

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims:

In Claim 2, column 27, line 5, “in” should be --is--.
In Claim 11, column 28, line 22, “tat” should be --that--.

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Application No. (if known): 10/560,995 Attorney Docket No.: 07700/066001

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